Space Weather Technical Forecast

Issued on Sunday, 25 September 2022 at 01:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1 Day 2 due to possible CME influence. Daily Chance of R1 Minor Radio Blackouts throughout

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity, as measured by GOES-16 and 17 satellites, has been Low with several C-class flares from AR3107 and AR3110. There are currently six numbered active regions on the visible disc, and a newly emerged unnumbered sunspot region near centre disc. The largest region is currently AR3110 (Eao/Beta) in the southeast quadrant. This region and also AR3107 (Eai/Beta Gamma), located in the southeast, are the two active regions generating most C-class flares. AR3109, in the northwest quadrant, appears to be simplifying. AR3102 is about to rotate off the southwest limb and AR3105 in the southeast quadrant has decreased in size and appears stable. The remaining regions in the southern hemisphere are largely unchanged and appear stable in nature.
Previously analysed CMEs from 21st and 22nd may give some glancing influence at Earth late on the 25th and into 26th, however confidence is low, and there remains a possibility of a later arrival on 27th.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, remained at mostly slightly elevated levels. The solar wind density was at mostly Average levels with a slight downward trend. The IMF was Weak, varying between 3nT and 8nT. The north-south component, Bz, was also at Weak, fluctuating between +4nT and -7nT, and was often negative (southward). The phi angle was changeable, showing alternating periods of positive (away from the Sun), and negative orientation (towards the sun). Geomagnetic activity was mostly Quiet to Unsettled (Kp 1 to 3), with an Active (Kp 4) interval 24/0300-0600UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, remained very close to Background levels. High energy electron flux (greater than 2 MeV) was at Normal Background to Moderate levels, with peak value 838 pfu at 24/1925 UTC. The associated 24-hour fluence remained well below the Active (1e8 integrated pfu) threshold. Observed fluence at 25/0000UTC was 1.81e7 integrated pfu with a rising trend from 24/1200 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low to Moderate, with further C-class flares Expected and an ongoing 50% Chance of M-class flares. The main flare risk remains from AR3110 and AR3107 on the eastern side of the disc.

Solar Wind / Geomagnetic Activity: This forecast period comprises a waning coronal hole fast wind (from CH25/+), up to two low confidence CMEs on day two (26th), and perhaps some limited coronal hole influence from CH26/- late in the period.
Ongoing influence from CH25/+ with slightly elevated solar winds will probably wane over the

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next couple of days, however there is a low chance of reaching G1 during day 2 from possible glancing CME influence. Potential influence from CH26/- late in the period should be limited, with G1 currently assessed as being unlikely. In summary, geomagnetic activity is likely to remain mostly below G1 level through the period.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES16, is expected to persist at Background levels.
The high energy electron flux (greater than 2 MeV) is expected to be mostly at Background to Moderate levels, with a chance of reaching High levels during the diurnal peaks over the next 36 to 48 hours. Confidence in the forecast is lowered due to possible glancing CME influence perhaps from either late on 25th, or more likely during 26th. However, the associated 24-hour fluence is expected to stay below the Active (1e8 integrated pfu) threshold through the period. MOSWOC REFM looks to be giving better guidance now and is tentatively accepted over the next few days.

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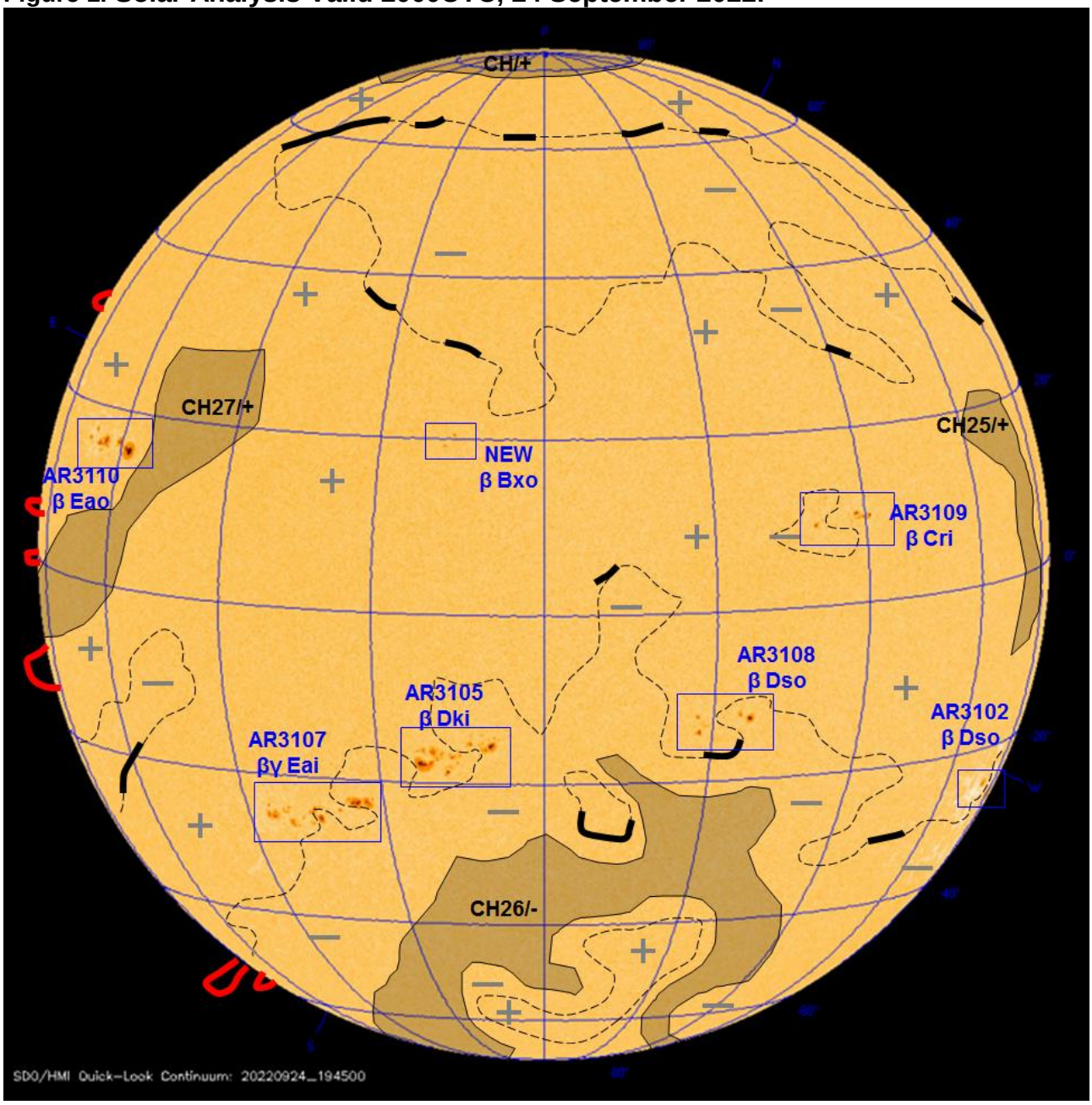
Figure 1. Solar Analysis Valid 2000UTC, 24 September 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

This forecast period comprises a waning coronal hole fast wind (from CH25/+), and two low confidence CMEs probably arriving on day 2 (26th), and perhaps some limited coronal hole influence from CH26/- late in the period.

Ongoing influence from CH25/+ is currently keeping the solar wind at slightly elevated levels and the forecast is for this to wane over the next couple of days. A further increase may occur day 2 from a possible glancing CME influence with a 30% chance of G1 intervals. Potential influence from CH26/- late in the period is most likely to be limited in impacts, with G1 currently assessed as being unlikely. In summary, geomagnetic activity is likely to remain mostly below G1 level through the period.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	30	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
22/0532	Partial	C-class flare perhaps AR3105	SE	309	Late 25 Sep or into 26Sep	Source uncertain, very low confidence. Probably independent from CME below
22/2058	Partial	AR3109	Centre NW disc	400	26 Sep, possibly 27 Sep	Low confidence. Mainly N and W of sun-Earth line

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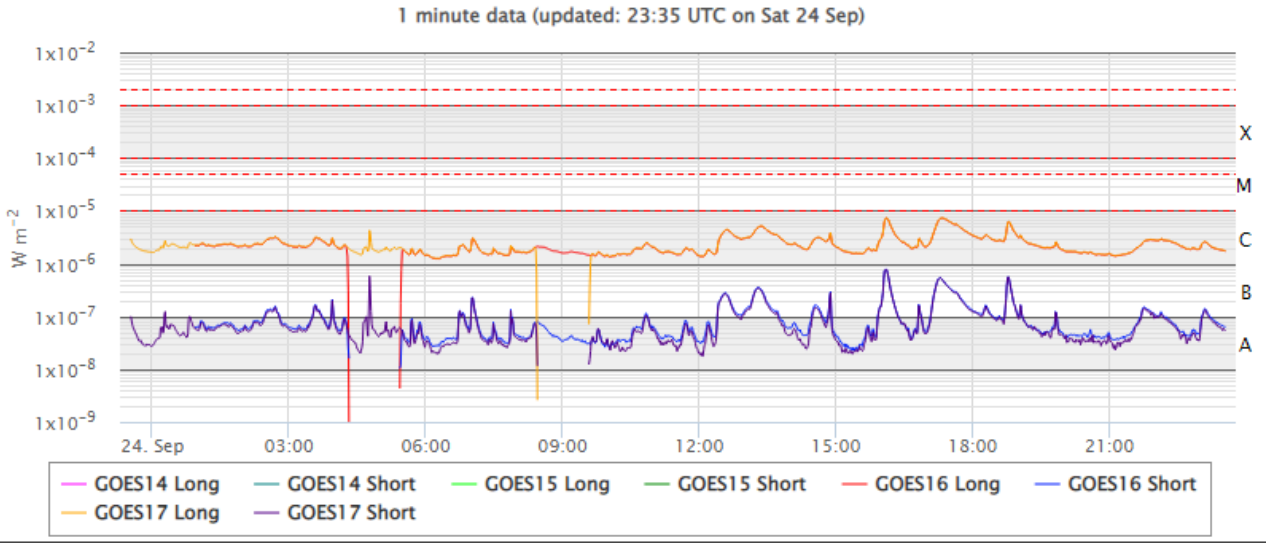
Radio Blackouts - X-Ray Flares:
Solar activity over the past 24 hours has been Low with several C-class flares observed, the rather more energetic of these occurring later in the UTC day from both AR3107 and AR3110 which are both located on the eastern side of the visible disc..
There are currently six numbered and one unnumbered active regions on the visible disc, with the largest currently AR3110 (Eao/Beta) in the northeast quadrant. This region and AR3107 (Eai/Beta Gamma), in the southeast, are both generating the majority of the C-class flares. AR3102 has simplified a little and is about to rotate off the southwest limb in the next few hours. The other region which has decreased in size, especially in the intermediate and leading portions is AR3105 in the southeast. The other remaining regions, although sizeable and prominently covering the southern hemisphere, are largely unchanged and appear relatively stable in nature.
Low to Moderate levels of solar activity are forecast, with the daily Chance of M-class flares assessed to be around 50%.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 2: X-ray flux plot from GOES data at GEO over past 24 hours with several C-class flares.



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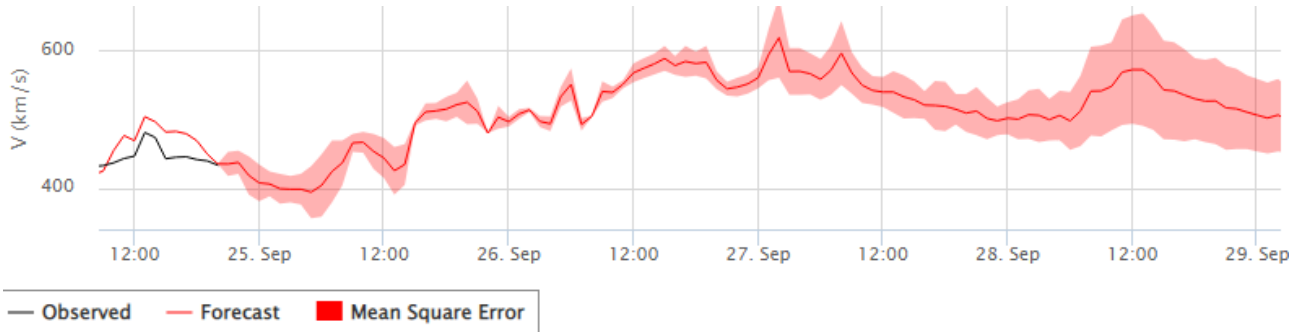
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10MeV) observed by GOES16 is expected to remain at or very close to Background levels.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 3: Met Office SWPM (Solar Winds Prediction Model).



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High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2 MeV) as observed by GOES16, is currently in the Normal Background to Moderate range.
The current influence of CH25/+ is lifting electron populations in Earth's Van Allen belts, with High flux levels perhaps developing during the diurnal maximum during days one and two (25 and 26 September). Confidence in the forecast is lowered due to possible glancing CME influence perhaps from late on 25th, and into 26th.
The associated 24-hour fluence is expected to stay below the Active (1e8 integrated pfu) threshold through the period, and this is reflected in the probability figures given in the table above. MOSWOC REFM looks to be giving better guidance now and is tentatively accepted over the next few days.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	30	30	20	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: High energy electron flux at GEO and Met Office REFM output.

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